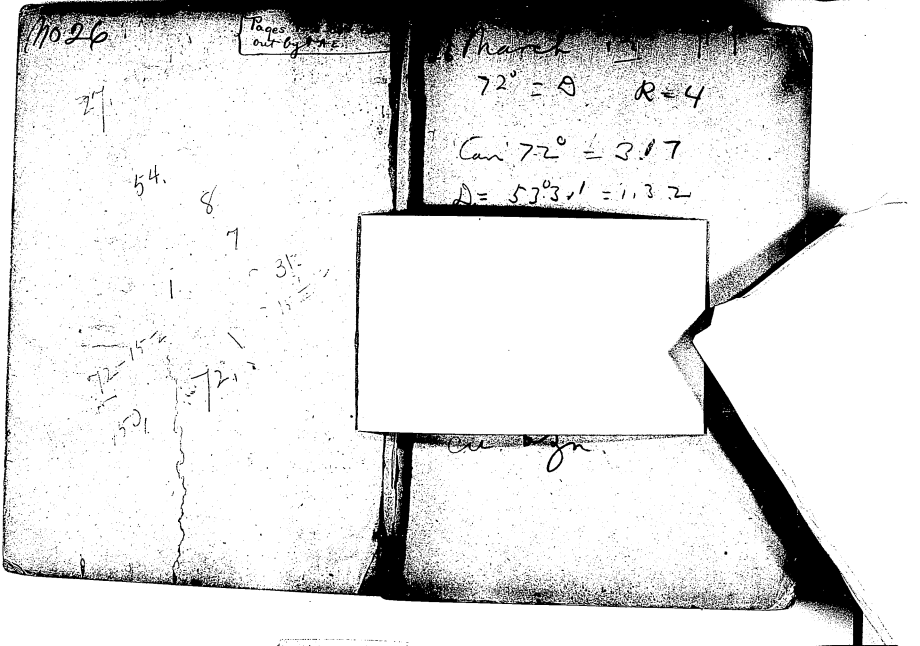
**Menlo Park Notebook #26 [N-79-02-20.1]**

This notebook covers the period February-July 1879. Most of the entries are by Francis Upton. There are also entries by Edison, John Ott, and Francis Jehl. Most of the material relates to electric lighting experiments. Included are extensive calculations by Upton about generators and electric power distribution, notes and drawings of lamps and generators, and calculations and drawings of meters. There are also tests of batteries and drawings of telephones. The label on the front cover is marked "Upton" and "Chem. Labor." The book contains 284 numbered pages.

Blank pages not filmed: 54-55, 112-115, 124-129, 136-153, 170-171, 238-245, 250-255, 258-279.

Missing page numbers: 1-4, 281-282.


11026
Pages cut-off
72° = θ R = 4
Can 72° = 3.17
D = 53°3' = 1.32

11026

Pages cut out here

54.

LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

GENERAL ELECTRIC.

_____, 189

March 1

$72° = \theta$. $R = 4$

$\cos 72° = 3.17$

$D_1 = 53°3' = 1.32$

$1.32 \times 4 = 5.28$

$1.175 \overline{)5.28}\ 3$

$525$

$3.07 \times 1.32 = 1.175$

3 Ohms Catland

2 cm between the

cu. bgn.

B = $\frac{a}{A-A_1}$ $R = 4$ Ohms

B = 73°

D = 49° 15'

3.27
1.15
2.12

1.15
4
2.12 ) 4.60 ( 2.2 Ohms
4 24
360

2.2 Ohms

Suppose 74°

3.48
1.15
2.33

2.33 ) 460 ( 1.9
233
2270
2097
3

Suppose 76°

401
1.15
2.86

286 ) 460 ( 16
286
1740

90° 30'
27°
29°

1 Right

28 30' L

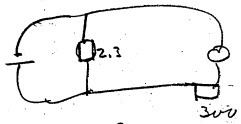
29.30'

29

28.0 R

360

2.3 Ohms
total




9 Ohms

27 Ohms

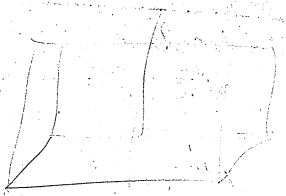
18° 45'

Good cell
.73 Ohms

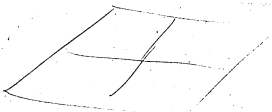
17°
.51 Ohms

73
51
1.24 Ohms

41° 30'



1.7



89 .33

| | |
|---|---|
| .12 | 1 |
| .12 | 2 |
| .11 | 3 |
| .05 | 4 |
| .02 | 5 |
| .02 | 6 |
| .01 | 7 |

14

1 20 ohms 3 speeds Number marked No. 30 or 29
10
10

1 5 ohms 2 mounted speeds No 27 28
2 2 ohm
5 1 1
3 .5
.2
.1
.1
.05
.02
.01
.01

15

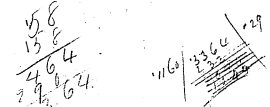
3 1 ohms

8 1/2

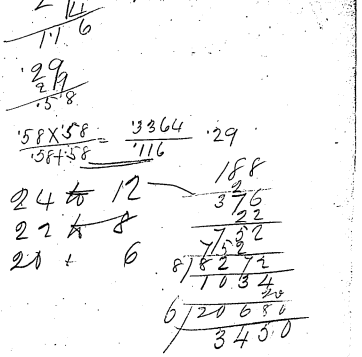
8 1/3

3 1/3 ohms

WL basket
5 lbs. 12 oz







Wt of bucket
5 lbs 4 oz
10° D = 10

2 lbs added
11° = D

4 lbs 3 oz
11° 30' = D

6 lbs 3 oz
D = 12° 30'



8 lbs 3 oz
D = 12° 30'

10 lbs 5 oz
D = 12° 30'

12 lbs 5 oz New Zero
D - 7° New Zero

14 14 4 6 oz
D = 8° 30'

14 5
2 1.5
16 lb 6.5 oz

D = 8° 30'

16 6.5
2 1
18 lb 7.5 oz

D = 8° 30'

18 lb 7.5
2 1
20 lb 14.5 oz

D = 11°

20 lb 3.5 oz
2 3.5
22 lb 12

D = 12°

22 lb 12
2 3.5
24 15.5

D = 14°

24 15.5
2 3.5
27 3

D = 15° 30'

27 3
2
29 3

D = 20°

29 3
2
31 3

D = 22°

31 ohms 30 ohms

2 15

33 45 D = 29

R = 8.5 ohms

33 45

2

35 4.5 D = 29°

R = 4.5 ohms

37 45 D = 29°

37 4.5

2 1

38 5 5 D = 33° 30'

10 inches

2

20

2.0

3.14

12 | 62.80

5.23 ft

5

38.53

5-23

11499

7666

19165

200.4659

200 | 33000

165 minutes

1 HP

102
86
612
816
8772
614040
2632
587

509
60
43540
.0072
81080
18780
326.8840

326

1020.60
138
23 | 1020 (46.3 ft.lbs.
92
100
92
80

44.3 ft. lbs. ~~f~~ given off by one Weber working over 1 Ohm

| | |
|---|---|
| 86 | 1.9345 |
| .675 | 1.8293 |
| | 1.7638 |

58 Volts E.M.F.

| | |
|---|---|
| 75.6 | 1.6785 |
| .760 | 1.6804 |
| 57. | 1.7593 |

| | |
|---|---|
| 86 | 1.9345 |
| 86 | 1.9345 |
| .675 | 1.8293 |
| 102 | 2.0086 |
| | 5.7069 |

.82
33 cm
246
246
270 60

509,000

| | |
|---|---|
| | 5.7069 |
| 138 | 2.1392 |
| | 3.5670 |

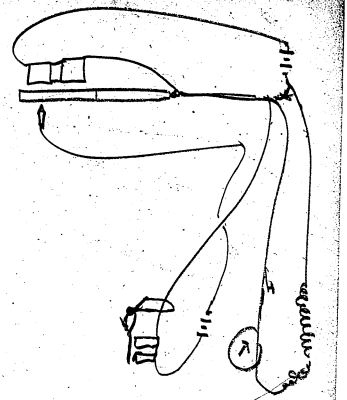
3,690 ft the second

| | |
|---|---|
| 60 | 1.7782 |
| 221.400 | |
| 33 cm | 5.4815 |
| | .8267 |

-10

6.7 H.P given off

Rock 8 lbs.



30

## Dynamometer

W = 8 lbs  No grounding
D = 2° 30
R = 40 + 30 Ohms

W = 8 lbs  Grounded
D = 2° 30'
R = 40 + 34 Ohms

W = 10 lbs  No grounding
D = 2° 30'
R = 40 + 35 Ohms

R = 40 + 32 Ohms
D = 3  Ground

W = 12  Ngr
D = 3°
R = 40 + 23

p+2 ?

37

W = 14 lbs
D = 3° 30'
R = 40 + 13

## New Shunt

W = 10 lbs.  D = ?
D = 9° 30'
R = 40 + 32 Ohms

W = 12 lbs.  D = ?
D = 11°
R = 40 + 22

W = 14 lbs
D = 13° 30'
R = 12

W = 16 lbs
D = 10.
R = 7 Ohm + 40

W = 18
D = 18° 30'
R = 40

W = 20
D = 20° 15'
R = 36 ohm

W = 22
D = 23°
R = 31 ohm

W = 24 lbs
D = 27°
R =



W = 26
D = 31°

W = 28
D = 37° 30'

W = 30
D =

30

$10 = R$

3.14

3

12 | 31.415

2.618

30

78.540

78.5 ) 3300.000 ( 430

3040

2600

2355

245

2/430

215



New Shunt

W = 8 lbs

D = 7°

W = 10 lbs.

D = 8° 45'

W = 12

D = 10° 15'

W = 14

D = 11° 30'

W = 16

D = 12° 45'

W = 18

D = 13° 30'

W = 20 lbs
D = 16° 30'

W = 22 lbs
D = 19° 15'

W = 24 lbs
D = 23° 30'

W = 26 lbs
D = 28°

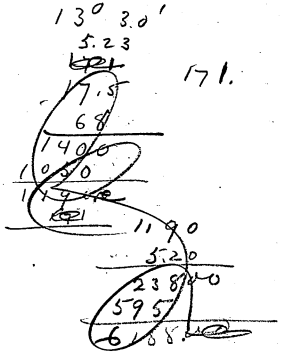
W = 28 lbs
D = 31°

W = 30 lbs
D = 37°



3.14
20
12 ) 62.80
52.3 ft
13.
1569
523
67.99
68. ft lbs

@ 771
68
1368
1026
17628 ) 33000 ( 1/3 H.P.






171 revolutions

17.5

5.23

17.5
171
175
1225
175
3192.5
5.23
6

15-0-0

1

100

| | |
|---|---|
| 11.75 | 1.0699 |
| 192 | 2.2838 |
| 5.23 | .7185 |
| | 4.0717 |

11.800

8° 15'

| | |
|---|---|
| 9.5 | 0.9777 |
| 192 | 2.2838 |
| 5.23 | .7185 |
| | 3.9800 |

9.550

33000 4.5-18.5

3.9800

.5385

3.4

192 9 1/2

128

1796

1824

7° 30'

8.75 .9420
192 2.2538
5.23 .7185 3.0023
3.9443

8.790 ft lbs

186
590

60

7 .8451
3.0023
3.8474

7.030

30 lbs .4771
180 2.2553
5.23 .7185
4.4509

28000



14° 45'

19 lbs 1.2788
5.23 .7185
180 2.2553
4.2526

18000 ft. lbs.

Gramme 620
commutators with revolutions
3 1/2 Ohms outside

44

19" 45

| | |
|---|---|
| 22.25 | 1.3472 |
| 186 | 2.2695⁻ |
| 5.23 | 0.7185⁻ |
| | 4.3352 |

21,600 ff lbs

45

34 lbs 1.5315⁻
2.9880
4.5298⁻

33200

10'

11.

Box 8 lbs

4 lbs = W
D = 5° 15'

8 lbs = W
D = 8° 15'

12 lbs = W
D = 11° 30'

14 lbs
D = 12° 45'

16 lbs
D = 14°



18 lbs
D = 16°

20 lbs
D = 17° 45'

22 lbs
D = 20° 15'

24 lbs
D = 26°

26 lbs
D = 28° 30'

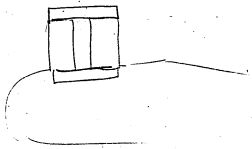
28 lbs
34° 15'

30 lbs.

80) 54.0 (.675
48
60

.67) 4.16





# Dynamometer

New magnet and oil cups.

15 cells carbon battery

1 lb constant for deviation Galvanometer using two on shunt 3 inches long. The needle vibrates two wd. Three degrees on either side of the zero as the files ~~and desper~~ cally the shaping machine fashions to be filed.

The plate founded on the back

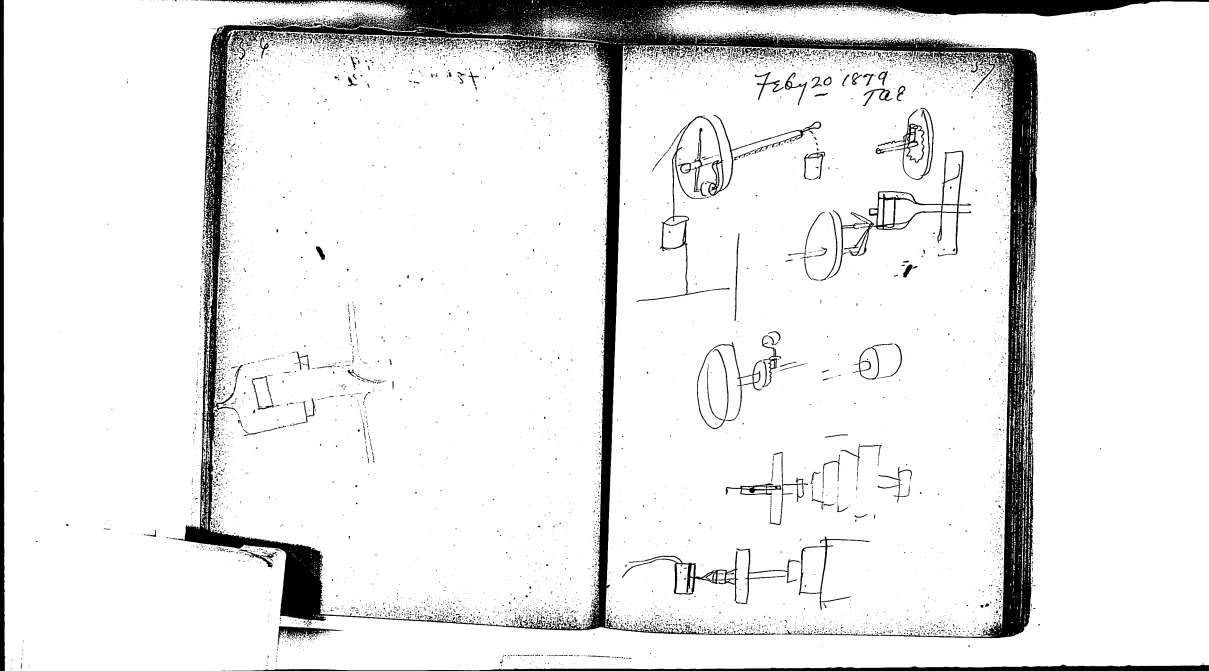


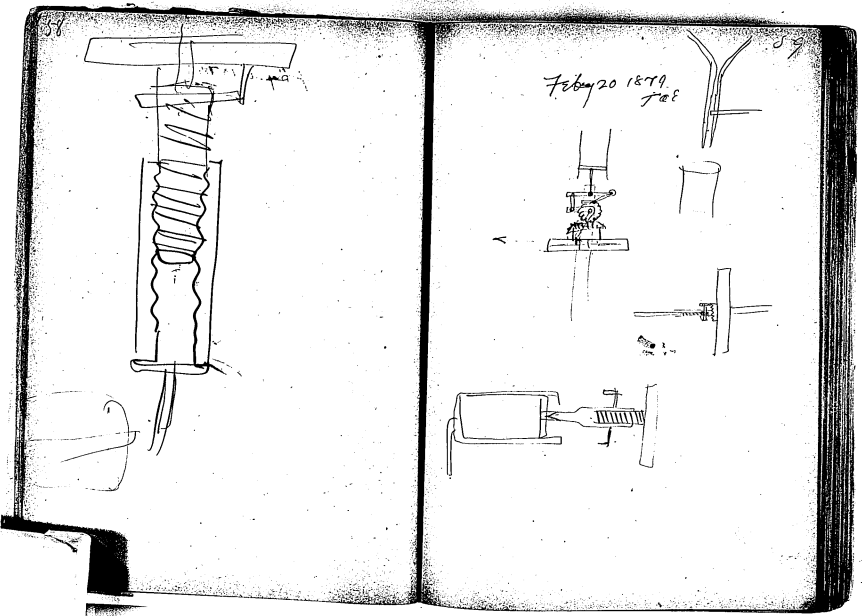
| | |
|---|---|
| 2 lbs | 8° |
| 4 | 11° 30 |
| 6 | 16° |
| 8 | 19° |
| 10 | 21° 30' shunt interval |
| 12 | 25° |
| 14 | 26° |
| 16 | 28° |
| 18 | 30° 30' |
| 20 | 32° |
| 22 | 32° 30 |
| 24 | 33° 30' |
| 26 | 36° |
| 28 | 37° |
| 30 | 37° |
| 34 | 40° |
| 36 | 43 |
| 42 | 47 |

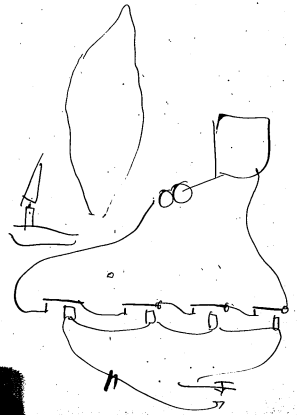
35 lbs

2700
35
13500
8100
94500

33000 ) 94500 ( 2.8 HP
66
285000
264000
210000

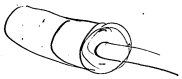

Feb 20 1879
JAB


38
Febry 20 1879
Tae
39

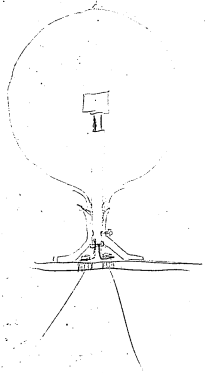


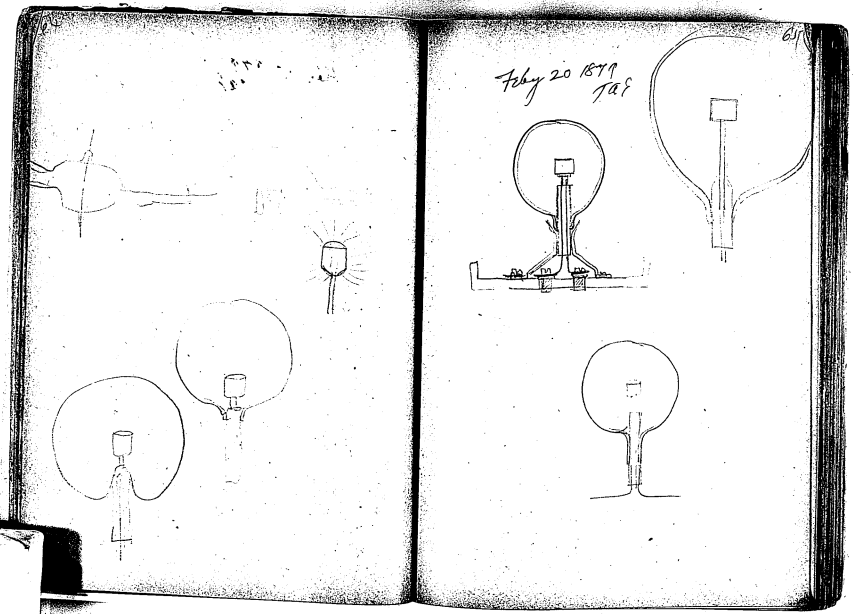


Feby 20 1874
TAE

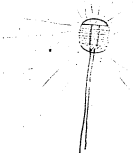


Feby 20 1879
JAE




Feby 20 1879
TAE

Feby 20 1879
Jas E



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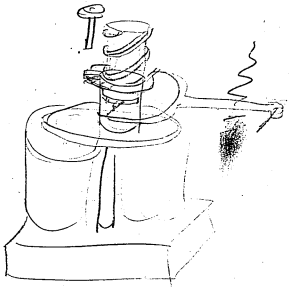
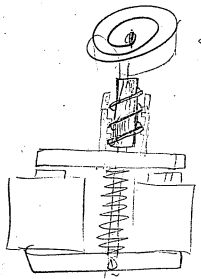
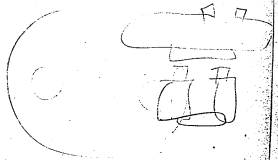
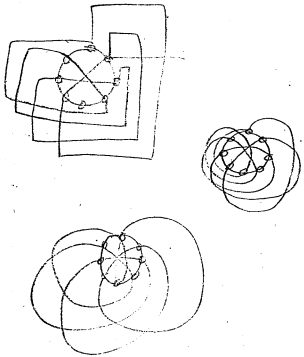




Feby 20
1879
TAP



Feby 27 1879
JAE



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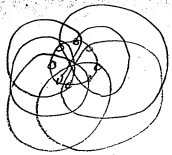
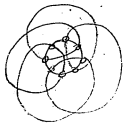
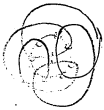
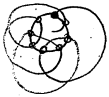
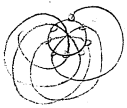


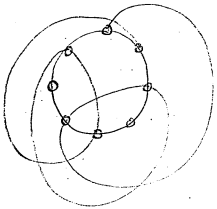


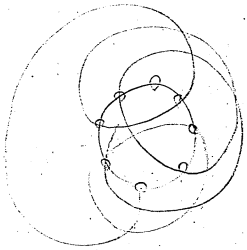






Feby 27 1879
JR.P



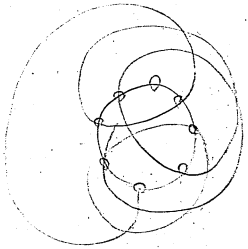


Feb 27 1879 Jas

77

1 3
225 : 77 : 175 : X
175 3
125
175
225
39) 39375

78



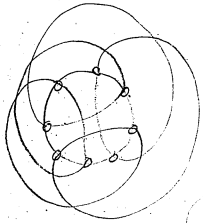
Feb 27 1879

17

1 2
22 5 : 7 : 175 : X
3
1 7 5
1 2 5
1 5 7 5
2 2 5
39 375

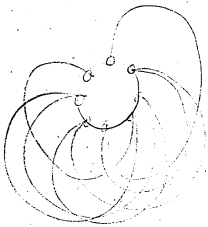
39

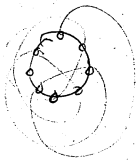
Feby 27 1879
Jas

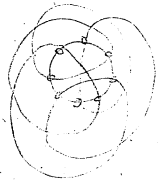


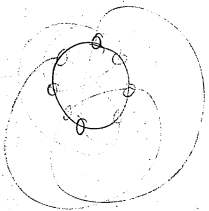
another
Gordian

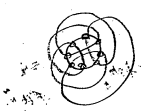
Feby 27 1879
Jal

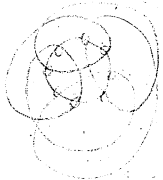


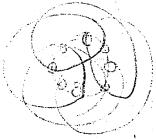






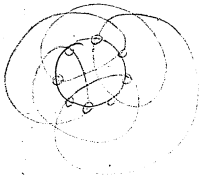


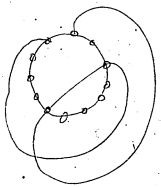






Feby 27 1879
Jas







Feby 27 1879
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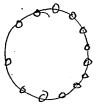
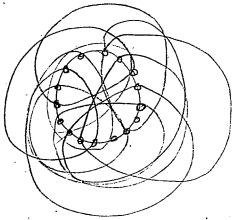
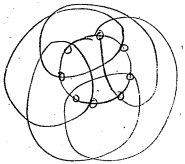




Feby 27 1879
Jas

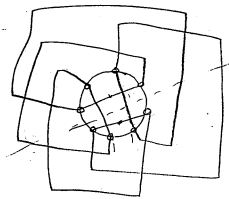


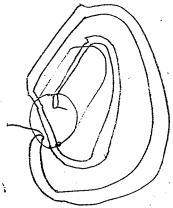
Good
Enough

92

93

Feby 27 1879 Jas





100 cells
~~90 cells~~
10 opposed
~~18~~ 2 Ohms

90 Volts

90
90
~~8100~~
~~1800~~
~~18000~~

8100

100 Volts

---

100 cells
50 opposed

50
50
2500
2
5000



100 cells
10 opposed
1 Ohm total

90 Volts

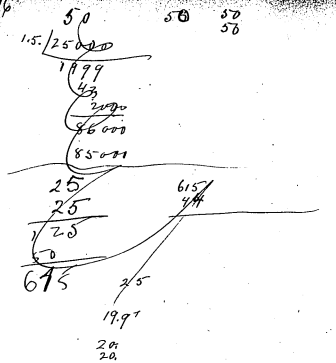
8100 units of E in resistance
90 units in cell

---

100 cells
50 opposed
2500 units of energy in resistance
2500 in work in cell

---

100 cells
60 opposed
1600 units of energy in resistance
2400 units in work in cell






25
25
comp 1.5
44.3

1.3979
1.3979
9.8239
1.6464
4.2661

18,400
3
43.200

50
50
2500

3.3979
9.8239
1.6464
4.8682

73800
2
147,600
73.800
221.400

In the case of two dynamo machines ~~when the~~ one transmitting the other receiving when the electromotive force is in the contrary one is

.25 Ohm 200 ft. resolv receiving to the other hundred 1 Ohm transmitter 100 Volts

25 Volts active



25 1.39794
25 1.39794
comp 1.25 9.90309
44.3 1.64644 1.54945
4.34533

22.100
3
66.300
22.100
88.400

4 | 150
37.5

37.5 1.57404
37.5 1.57404
1.54945
4.69753

49.800
3
149400
49800
199 200

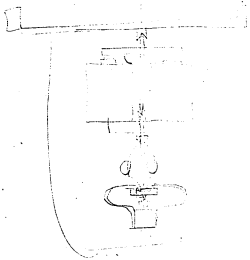
100

37.5 1.5740
37.5 1.5740
Comp .75 1011249
44.3 1.6464
4.9193

83000
3
249000
83000
332000

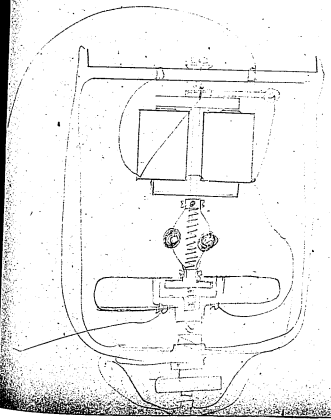
101

March 8 1879
JAE



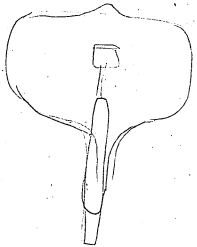
Mch 10 1879

Tai



20. 20 cut 100 000 feet ch

or



| | | | | |
|---|---|---|---|---|
| 1 | 50 in | 50 cut | 1 | |
| 1 | 33⅓ in | 66⅔ " | 2 | |
| 1 | 25 in | 75 " | 3 | |
| 1 | 20 in | 80 " | 4 | |
| 1 | 16⅔ in | 83⅓ | 5 | |
| 1 | 14⅓ " | 86 | 6 | |
| 1 | 12 " | 88 | 7 | |

½ 12½ . 37½

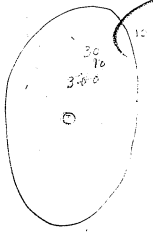
3 . 22

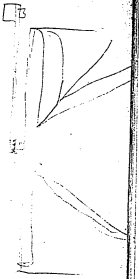
25



March 16 1879

100 TA



20. 1 ch

5 Pighi. 8

5¼

1 ohm  1 ohm

20 Pumps out 20 in 100,000 ffbs

or 5000 ffbs per lamp

~~20 Pumps out 20 in~~

20 Pumps out 6 ½ lamps in 100 000 ffbs

2. 100 000

4 5-8

10. 5 8 25-

15- 5- 50 000

33333 ffbs

15- 33-50

3 150

5 1750

3500

1250

Ap. 1.

25

100,000.



15- 3 ohm lamps  1 ohm machine

Apply 100 = 20 ft lbs

25

or 5000 ffbs per lamp

Can only apply 5000 ffbs

with Standard R. 3350. ft lbs

with 4 lamps R. 2834 "

2834 | 19 2

22 | 2

223 | 7

237 | 6

6 | 2

2850

5

2 | 2 5 0 0

1 | 7 1 0

2850

10 lamp

20 75-

8 75

4

32,300.

35 as against 20

besides having

20

8 : 15 35

32 500

100. 8 75 1. 25

12½ 61 2 5 87 5

7 0 0 0 25

8 5 3/4

47

97 1 48

56

0.047

118 6 00 5 4 5 8

.84 8 8

20 Lamps

March 100 dollars interest 10 year

Cost power 90 per year

$35 per Lamp. 100

Equivalent

4 interest 350, 40

power, 90

only 3.75 per lamp $ 130

$ 5.8 to run 90 64

60 90

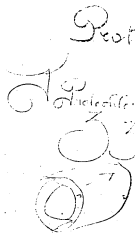
90 : 60 3.07

90 60

63 56

44

Protoclifoxide



Z Zircon

Zirconium

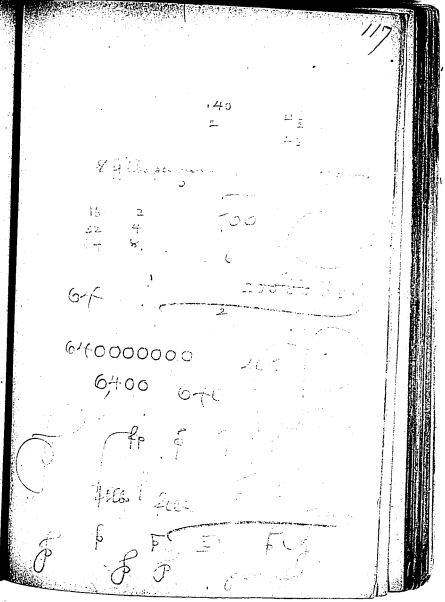
Zirconium

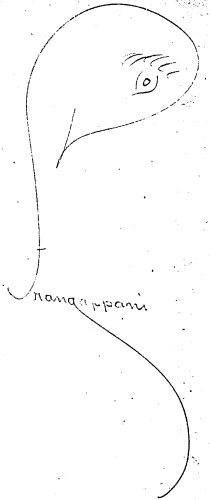
Zirconium

Magnesium

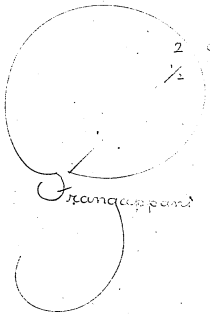
Magnesium

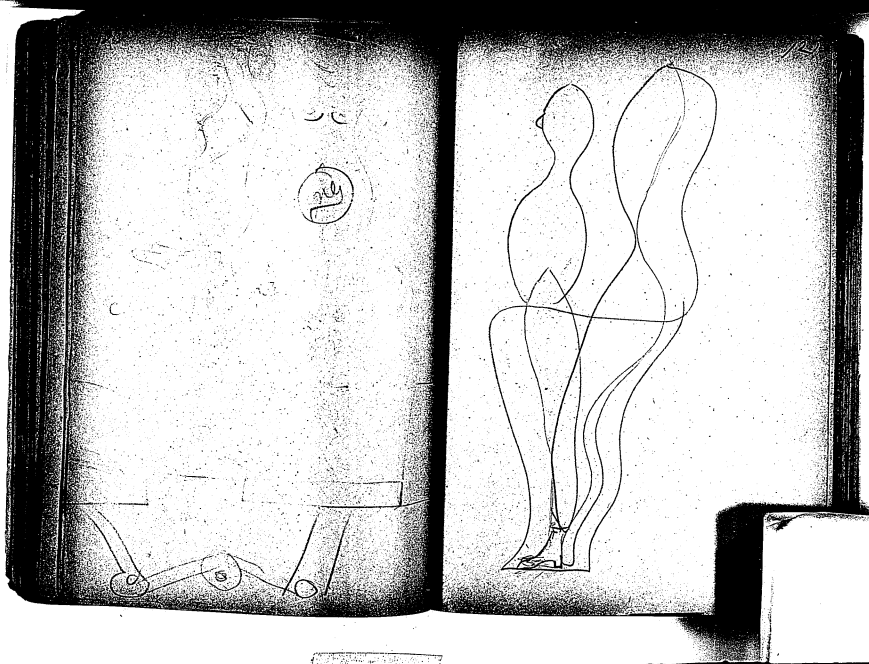


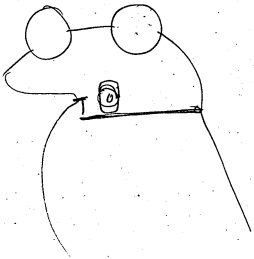



Папаграпи



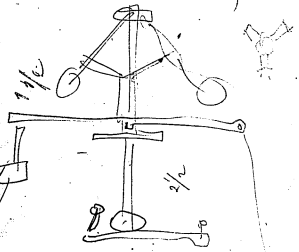

2 Linien
½
Papagrapti







Mch 20 1879




6

132

66 6666
66
6
3
1½

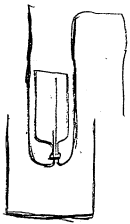
133

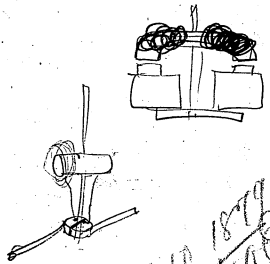
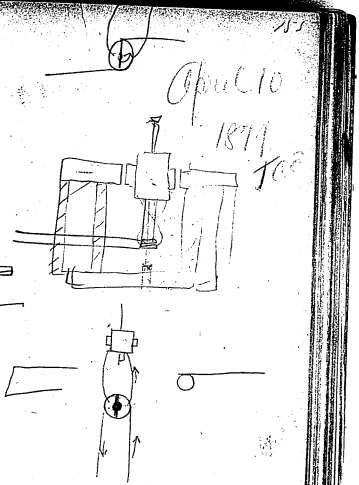
1 in 1 out.

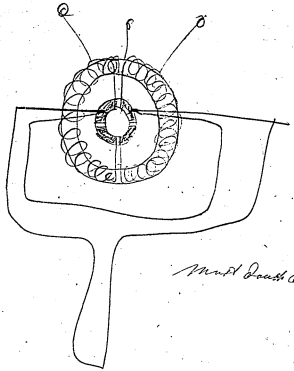
66
4
2/264.
132 Carbon

1326
13 360963
132

Up 2250

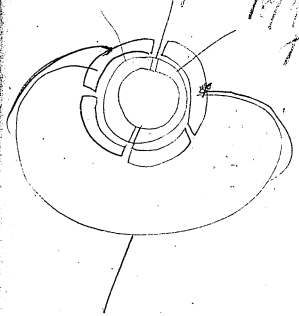


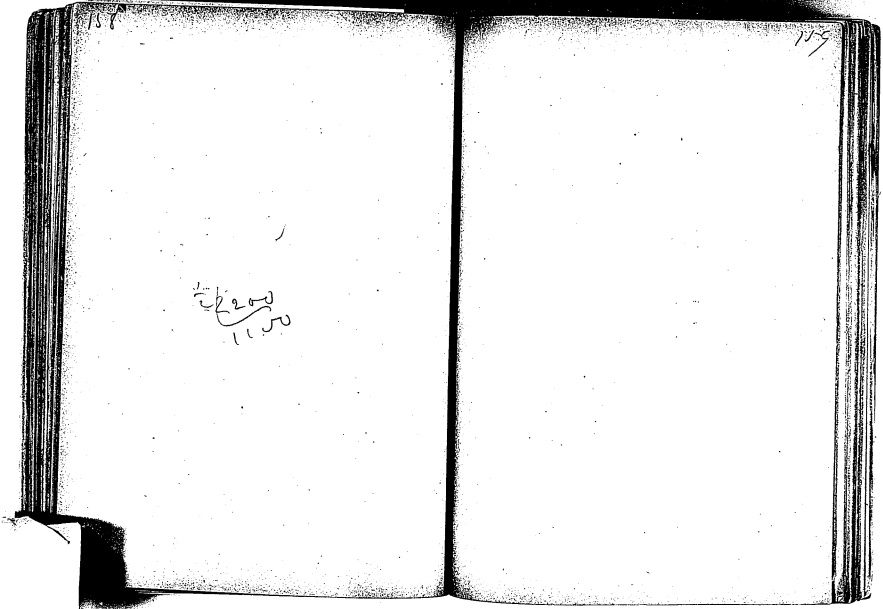

April 10
1879
TAE

April 10
1879
TAE

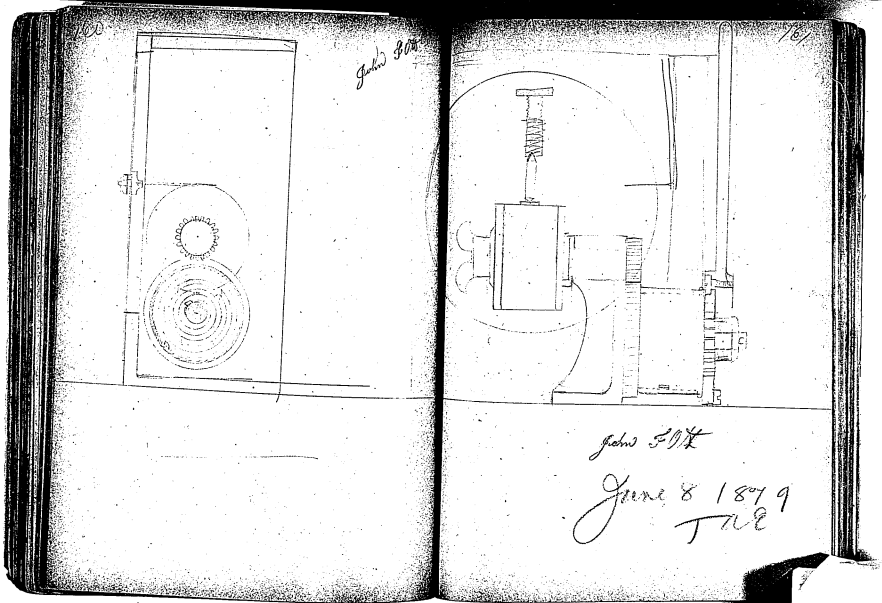




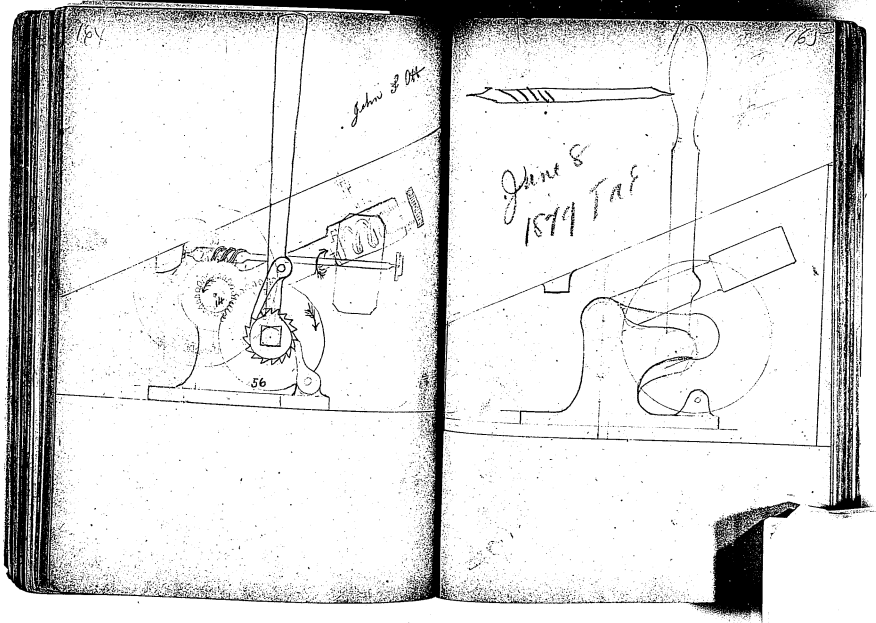
april 10
1971

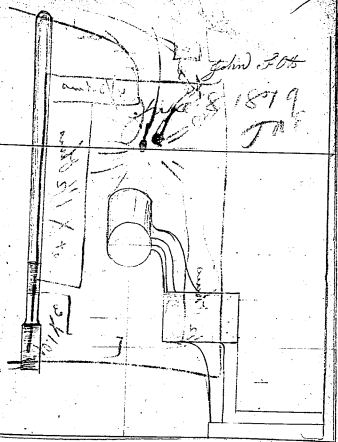


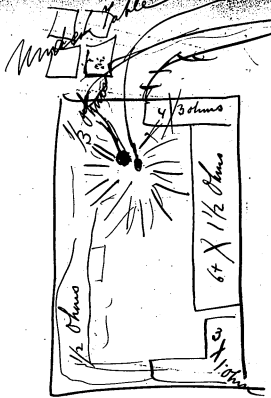



John Fox
John Fox
June 8 1879
TLE

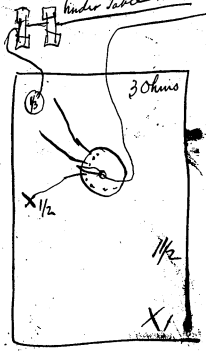
June 8 1879
TMP

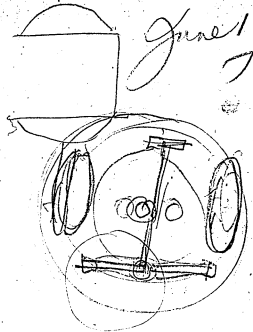

John S Ott
56
June 8
1869 T&F



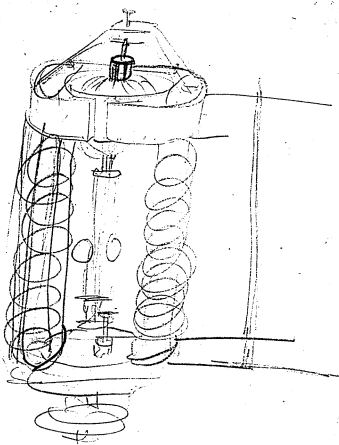

4 X 3 ohms
6 X 1½ Ohms
3 X
½ Ohms




30 Ohms
X ½
1½
X 1

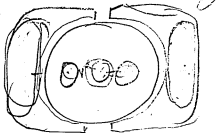




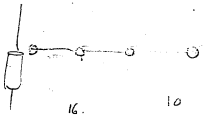


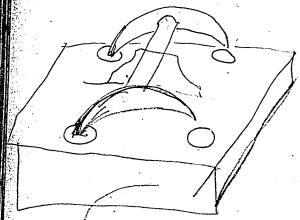
June 1 1879

TAC



16

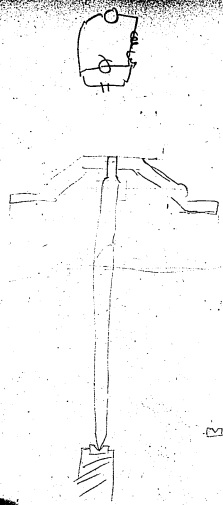




1

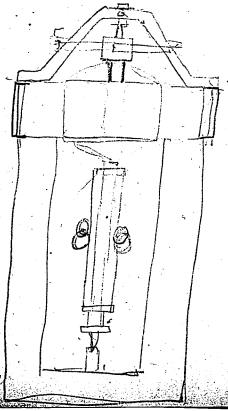
June 10 1879
TRT

100, 100,





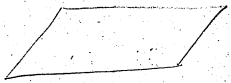
June 10 1879
Jay

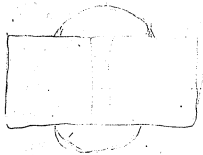


$$\begin{array}{r} 314 \\ 157 \\ \hline 471 \end{array}$$

$$15 \quad \frac{14000}{15}$$

64





P. [illegible]

Resistance of Brandley box
.14 Ohms

Test of Battery 1883

Carbonate of Cu, moistened in porous cup with Cu plate. Outer cell saturated solution Ammonium Chloride Amalgamated Zn.

July
E. M. F. .89 Daniells

Internal resistance 1.4 + .14 = 1.54

Put on short circuit

| | | |
|---|---|---|
| 12-30 | M. | 32° |
| 1-5 | P. M. | 25° |
| 1-60 | " | 21° |
| 3.30 | " | 21° |
| 4.25 | " | 19 |

184

35' Sr. 6 o'clock, after Taking off the currents for a few minutes

27° a.r. from F P. Wm

9.30 a.m. next day 10 degrees being on about ~~it~~ currents are right.

185

35°

186 at 75° F

.35

at 75° F 187

| Fuel | Dia. | Rel |
|---|---|---|
| 50 | .040 | .35 |
| 50 | .050 | .22 |
| 50 | .080 | .09 |

188 Large size .127 3/4

12 inches = resistance bridge
12 in of it to make .03 ohms
2 feet to be deducted

47-2 = 45 feet = .03 ohms

.126
.127

9.83 wire from Cu
.1 foot [illegible]

9.82
Comp x128.
x128.
45
1.00382
24.
1091

0.9926
9.8928 = 10
7.8928 = 10
1.6532
.4309
.0374
2.4683

27
2.94 ohms

.00382
24
1528
764
.09168

Temp. 75°7
32
43
5
9 | 215
24.

98%

Another wire .10025

.07 Ohms 71.0692

65 ft 10½ inches

9.82 .9921
100.25 7.9990
7.9990
65 1.8129 94%
2.8030
.0635 .0374
2.8035
.0692 Ohms

9.718 .9872
7.9990
7.9990
1.8129
.0374
2.8355

1692
.99%

9.94 .9974
3.8483
1.8457

7.01 Ohms if compounded

to diameters wires as given by Jenkin.

Take half the log of the wires and subtract 3.4109 from this which gives the log of the Webers



.080

.12 Ohm

70 feet

| | |
|---|---|
| 9.82 | 0.9921 |
| 80 | 8.0969 - 10 |
| 80 | 8.0969 - 10 |
| 70 | 1.8451 |
| 1.09 | .0374 |
| | 7.0684 |
| .117 .12 | 7.0792 |
| | .9892 |

97.6 %

192

.050

.26 Ohm

58 feet 3/4

58.75 feet

| | |
|---|---|
| | .9921 |
| 50 | 8.3010 |
| .50 | 8.3010 |
| 58.75 | 1.7691 |
| 1.75 | 0.0374 |
| | 1.4006 |
| | 1.4150 |
| | .9856 |

25.1

= 5.1

96.7%.

193

.040 m = D

.41 Ohm

59 feet

| | |
|---|---|
| | .9921 |
| .09 | .0374 |
| 40 | 8.3979 |
| | 8.3979 |
| 59 | 1.7709 |
| | 1.5962 |
| | 7.6128 |
| | .9834 |

39.4

96.3%

| R | 7t | Di |
|---|---|---|
| .07 | 66 | .1005 |

.1005 = Diameter

| | | |
|---|---|---|
| log | 9.83 | 0.9926 |
| comp | 100.5 | 7.9979 - 10 |
| comp | 100.5 | 7.9979 - 10 |
| log | 65 | 1.8129 |
| log | 1.09 | .0374 |
| | | 2.8387 |
| | .07 | 2.8451 |
| | | .9936 |

98.5 %



| R | | | | |
|---|---|---|---|---|
| .07 | 210 | .101 ✓ | | |
| | | .1005 ✓ | | |
| | | .101 ✓ | | |
| | | .1005 ✓ | | |
| | | .100 ✓ | | |
| | | .101 ✓ | | |
| | | .100 ✓ | | |
| | | .101 ✓ | | |
| | | .101 ✓ | | |
| | | .101 ✓ | 10 | 110 |
| | | .101 ✓ | 9 | 100 |
| | | .1005 ✓ | | |
| | | .100 ✓ | | |
| | | .100 ✓ | | |
| | | .100 ✓ | | |
| | | .1005 ✓ | | |
| | | .100 ✓ | | |
| | | .1005 ✓ | | |
| | | .999 ✓ | | |
| | | .100 ✓ | | |
| | | .1005 ✓ | | |
| | | .100 ✓ | | |

July 29 1879

Testing samples of copper wire received from the Anaconda Brass and Copper Works; and comparing it with pure copper ~~at~~ one foot long and $\frac{1}{1000}$ th of an inch in diameter at 0° C.

Large size. ~~1235~~

Diameter. 12 7/4

with the above wire it required above 12 inch of the wire to balance the bridge, and about 12 inch had to be taken, in order to make the rest contain a resistance exactly of .09 of an ohm. Two feet had therefor be deducted which leaves 45 feet.

12 in. R. Bridge + 12 in taken = 24 in

2 ft − 47 = 45 ft = .09 ohms at 75° F.

How do you do

How d

Increase of the resistance of the lamp

25 gram Antaste

Electrotype

Sewing Machine



Conductors

1 Ohm

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

New Machine

Armature Wire .071 1/2 in. in diameter average c/o measurement

Resistance .60 Ohms

The wire all wound

4 5/16 surface 3/16

1/16 1/8 1/16 1/16 1/16

1/16 1/16 1/16 1/8 1/16 1/16

1/16 1/16 1/16 1/16 1/8 1/16 1/16

1/16 1/16 1/16 1/16 1/16 1/16

1/2 the surface ~~1/2~~ the energy on the same surface 2/1

Double the energy quadruples the light. ~~Ex~~ That is on the two halfs of the surface each with the same energy gives off twice the light. Therefore Edison's law halfs the surface and double the light with the same energy

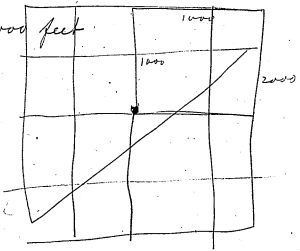
1 1/16 3/16 3/16 5/16 3/16

9 9 9 9 9

202

10 lamps 1/2

2000 feet



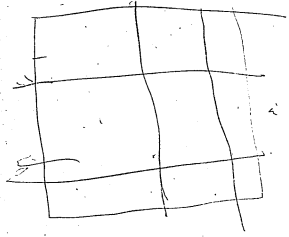

#10 #10

203

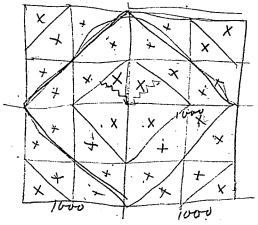
2 wire

5 2 5 2

200/528 2/5 mile



Conductor




$31.25 cost for 1 hour
at distance of 1000 feet or
2000 feet of wire

.79



79 WAB

WAB48

Fall county

Question: How many hours

Say three hours

$30

$10 $20 $30 $30

$20 $20 $20 $30 $30 $30

$20 $20 $20 $30 $30 $30

$30 $30 $30 $30

$30 $30 $30

$30

$30

206

If $30. were invested for each lamp at the hours used at the hour when the most current is required taking three hours as the average use of the full capacity.

207

2 cts an hour

1/2 ct for H.P.
6 hrs H.P.

20 lamps per machine

$5 for machine

$15 for conductor

100 cells
50 cells
1 Ohm
1 Ohm

50

150 cells active

100 cells active
50 ... ...





100 Ohms ÷ 75

25 Volts
1.25 Ohm

20 | 33
1650

11000 | 33.000
3.3

50 50 50 50 50
50 50 50 50 50 50
50 50 50 50 50 50 50

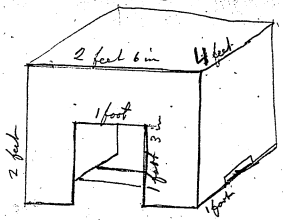
I think the current from a dynamo machine driven by another machine doing work is comparable to that from a battery in which the work is absorbed by another battery



25
6.25
3
1875
44

3.2729
1640
4.9193

83000






larger 26.838

smaller 16.261
16.867
.506

Ten Volts = 100

over 3.56 Ohms 39

39.5

The deflection 70 on .05 Ohms

The deflection 19.5 around 3 Ohms

52. around cell



3.56 | 3.90 ( 1.09 Webers

3 56

34 00

32 04

1960

1.09 Webers give

70 on .05 Ohm

70 X 20

1.09 | 1400 ( 1280.

109

310

218

920

1280

3

3840 | 19.500 ( .005

19200

300

$\frac{1}{200}$ Of Webers

1 Ohm

30 | 16.6 mg

1.09 | 20.2. | 18.5.

1.09

930

872

580

545

35

18.5

60 | 18.5.

30.83

18.5

60

3 | 1110.0 per hour

277.5

3

5 | 8325

1665

1 Weber deposits 18.5 mg per minute of Cu

.00297

That a current of 3/4 of a Weber shall deposit 5 mg per hour ~~in~~ the deposition cell must be on a shunt so that 1/166.5 of current shall flow through it

In case page 207 Book No 25

.873 Webers | 7.9410

.00297 | 3.4727

2.4683

1/294 of current flowed through the shunt with six Ohms in the line ~~resistance~~ with the cell shunted by .03 Ohm

3-05 P.M

38.5
around 3.56 Chin

215

80 around .05

39 around three others in chunk
58
73

100
1600
160 pesos

The current from four cells of carbon battery allowed to run through a circuit containing a deposition cell and 16.417 grammes were deposited.

A plate was put in the ~~the~~ a shunt and .080 ~~for~~ deposited or $\frac{1}{205}$ of that in the main line.

Measurements with the galva. showed that $\frac{1}{160}$ of the current flowed through the element when the current was strong. This is a good showing for the meter.



20 | 172
8.6
10
18.6
3.27
744
372
558
60.264

3
105
3
324

81 Volts

53 : 245 : 121

53 ) 245 ( 4.58
212
310
265
450

81
81
81
648
1561
443
25683
44

4.58
21
458
1
26.78

19.4

| | |
|---|---|
| 19.4 | 1.2878 |
| 4.53 | .6561 |
| | 1.9439 |

89 Ohms

| | |
|---|---|
| 81 | 1.9085 |
| 81 | 1.9085 |
| 44.3 | 1.6464 |
| | 8.0581 |
| | 3.5215 |

3320

Test of .042 wire

.047 31.5 feet old
.047 3
.047 94.5 .56 Ohm
.048
.047

.042 new

.80

.041 5
.040 5
.042
.040 5
.041
.040 5



Plan to pursue

Proof that lamps or heaters consume the current in multiple arc or

Those Measured by current

Rey curtain rise in S. in F.
Tests

Berg solution attacked plates
impure plates

Different solution, test
Corrosion loss established

Durable plates

1 lamp $C = \frac{\mathcal{E}}{R}$

$n$ Lamps

$$C = \frac{\mathcal{E}}{\frac{R}{n}} = n\frac{\mathcal{E}}{R}$$

$$C = n\left(\frac{\mathcal{E}}{R}\right)$$

Work in lamps

$$W = C^2 R = \frac{\mathcal{E}^2}{R} \quad W = \frac{\mathcal{E}^2}{\frac{R}{n}} = n\frac{\mathcal{E}^2}{R}$$

$$W = n\frac{\mathcal{E}^2}{R} = n\mathcal{E}\frac{\mathcal{E}}{R} = n\mathcal{E}C$$

proportional to $n$

Meter deport proportional to $n$

Meter proportional to Work

Work on lamp $= \mathcal{E}C$

Motor $\frac{(\mathcal{E}-\mathcal{E}_m)^2}{R}$

$$\frac{\mathcal{E}-\mathcal{E}_m}{R} = C$$

$\mathcal{E}-\mathcal{E}_m : \mathcal{E}$ :: Work on resistance : Total Work on Motor

$\mathcal{E}-\mathcal{E}_m : \mathcal{E}$ :: $\frac{(\mathcal{E}-\mathcal{E}_m)^2}{R}$ : Total Work on Motor

Total work on Motor $= \frac{\mathcal{E}(\mathcal{E}-\mathcal{E}_m)}{R}$

$$= \mathcal{E}C$$

Work on Motor $= \mathcal{E}C$

The E. M. F. remaining constant the current [illegible] passes through a motor is proportional to the work done whether the work be in the form of heat or motion.

1 Weber of current deposits
19.6 Milligr. in a minute
of Cu.

19.6
60
1176.0 Milligr

1.176 Gr an hour

A 100 Ohm lamps
giving at the rate of
19 lamps for a horse
power in the current
require .864 Webers of
current

1.176
.864
4704
7056
9408
1.016064 Grammes an
hour will be deposited

by the current which
is required to run one
lamps if the voltameter
is placed in the main
circuit

If a lamp consumes 5 feet
an hour and it is wished
to make the meter indi-
cate 5 Milligr the
shunt ratio must be
1.203

5/1.016
.203

If the meter be shunted around .05 ohm there will be an E.M.F of $\frac{.1864 \times .05}{.05} = .0432$ Volts

.043200

The contrary E.M.F of Cu solution is .05 so that it was thought impossible to indicate the first lamp.

Experiments were made that showed that the contrary E.M.F was not a constant but rose with the exciting current being for very weak currents extremely weak

Book 25 page 203

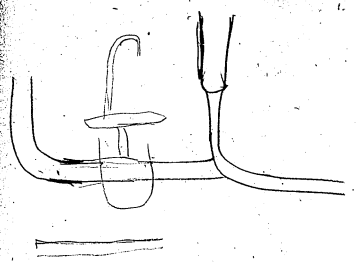
Solutions attached plates

Book 25

Double plates

Book 25 p 255

Tests



165 on Camp

225

73.5

165 : 225 :: 73.5 : x

225
3675
1470
1470

.165 ) 165 3 7.5 ( 100.2
165
375
330

19
81

84
84

2796 | 33000 (12
2796
5040
2796
22440

44.3
345392
3453

33000 =
X

100 ; 81 :: 345.3 : X
81
345.3
27624
27.9.6.9.3

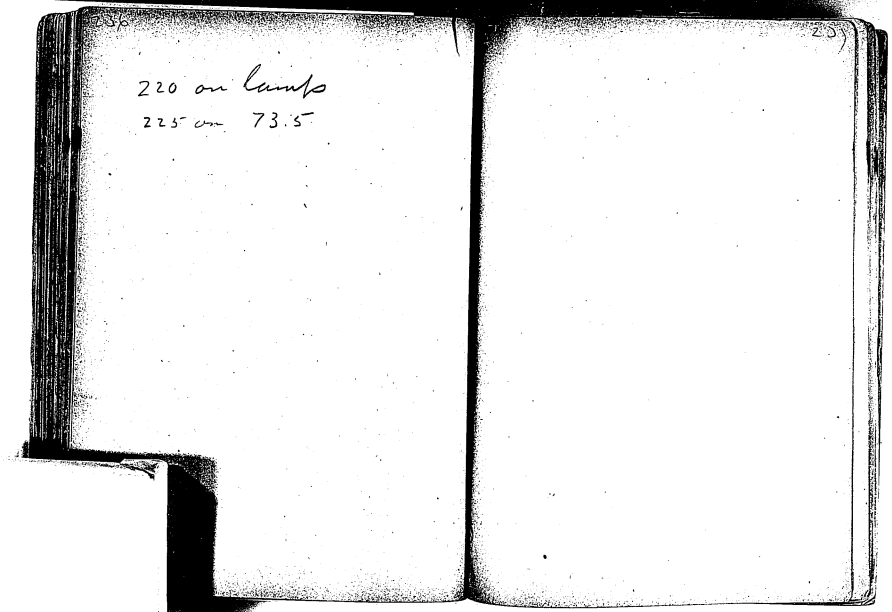
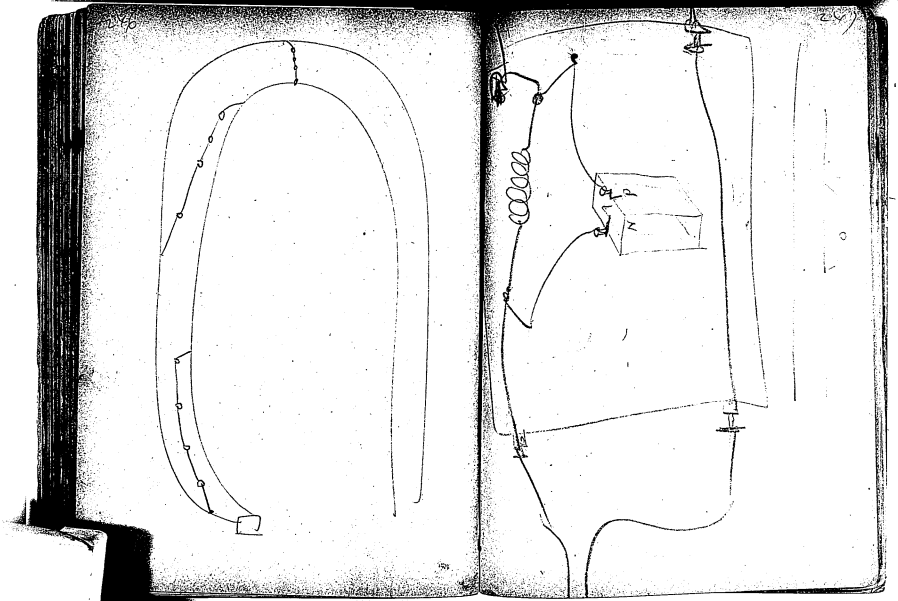
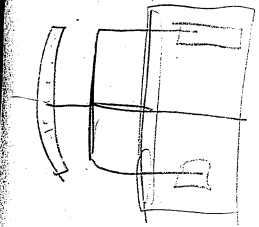
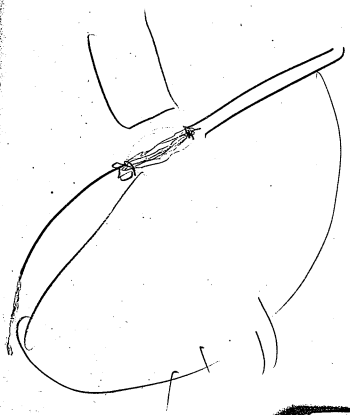
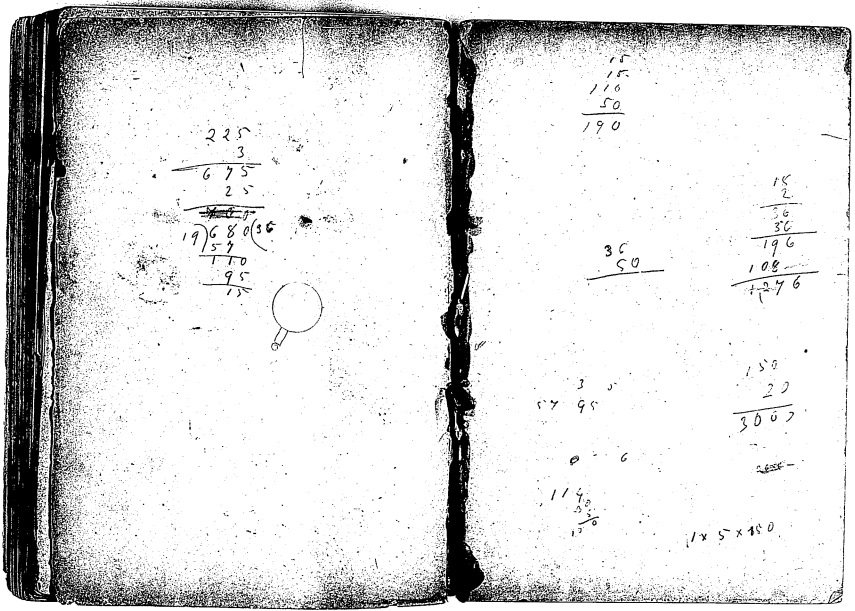
106.6 | 345392 (3240
3198
2559
2132
4272
4264



155 : 225 :: 73.5
225
3675
1470
1470
155 | 165375 (106.6
155
1037
930
1075
22
846

106.6 : 84.6 :: 3240 : 846
20718
13812
26424
106.6 | 2801238 (2
3240
84.6
19440
1296
25920
106 | 274100.0 (2586
212
621
530
910.4
848
620

2586 | 33000 (12.
2586
7140
5172
19680


220 on lump
225 on 73.5